

SPECIFICATIONS

FOR

TANK

FABRICATION

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STANDARD SPECIFICATIONS FOR FABRICATION, ERECTION AND TESTING OF ABOVE GROUND STORAGE TANKS

1.0 SCOPE

- 1.1 This specification covers the minimum requirements for design, selection of materials, fabrication, erection, inspection, testing, fitting of other attachments and appurtenances, cleaning, calibration and painting of A/G FLOATING ROOF/CONE ROOF PETROLEUM PRODUCTS AND OPEN TOP WATER storage tanks and is intended to supplement the minimum requirements of the applicable codes.
- 1.2 Engineering drawings shall take precedence over specifications/standards.
- 1.3 The Review/ approval of design by HPCL shall not absolve Contractor from the responsibility of successful performance of Floating Roof/Self supporting cone roof. It shall be the sole responsibility of the Contractor to ensure successful performance of Floating Roof design.
- 1.4 **The Shell and Wind Girders have been designed by HPCL as per API 650(latest Edition). However the Contractor shall independently verify the above design and confirm his verification of adequacy of the steel plates (Free issue materials) to be supplied by HPCL immediately after award of the contract.**

2.0 REFERENCE

2.1 Design Codes

The following codes in their latest edition shall form the basis for design, fabrication, inspection, testing and acceptance of storage tanks :

IS 803 (Latest edition)	:	Vertical Mild Steel Cylindrical welded Oil Storage tanks
API Standard 650 (Latest edition)	:	Welded steel tanks for oil storage.
IS : 875 (Part 3) Wind Loads	:	Code of practice for design loads other than earthquake) for building and structures.
IS: 1893	:	Criteria for earthquake resistant design of Structures.
API : 2000	:	Venting atmospheric and low pressure storage tanks.
IS : 2007	:	Method for calibration of Vertical Oil Storage tanks.
IS : 2008	:	Method for computation of capacity tables for Vertical Oil Storage Tanks.

API : RP 2003	:	Protection against ignitions arising out of static, lightning and stray currents.
OISD-129	:	Inspection of storage tanks.
OISD-117	:	Fire Protection facilities for Petroleum depots and Terminals.
OISD-118	:	Layouts for Oil & Gas installations.
OISD-105	:	Work permit system.

2.2 Materials Codes

Material to be used shall conform to:

Indian Standard Specifications or ASTM standards as applicable.

2.3 Regulations

National laws and regulations together with local bye-laws for the country or state wherever the tanks are to be erected must be compiled with.

3.0 SELECTION OF MATERIALS

- 3.1 All materials shall be as per applicable Codes.
- 3.2 Manhole necks, nozzle necks 350 mm NB and above may be fabricated from same plate material as used for shell.
- 3.3 Plate material used for ring flanges shall have a minimum UTS of 4200 Kg./cm² . For Flange thickness over 38 mm, plate material shall be boiler quality, fine-grained, killed, and normalized and impact tested as per the requirements of API Standard 650.
- 3.4 All clips and attachments shall be fabricated from carbon steel plates of weldable quality.
- 3.5 Gaskets for manholes and nozzles fitted with blind flanges shall conform to IS: 2712. Thickness of gasket shall be 1.5 mm for nozzles up to 450 mm NB and 3.0 mm for nozzles above 450 mm NB.
- 3.6 Bolts and nuts for all nozzles fitted with blind flanges shall conform to ASTM A-307 Gr. B, A-193 Gr. B-7, or A-194 Gr. 2H. Bolts and nuts for all structural shall conform to IS: 1363.
- 3.7 Floating roof pipe supports and pipe sleeves shall be of carbon steel conforming to ASTM A-53 /IS: 1978.
- 3.8 Following classifications of electrodes are recommended for welding. However, minimum requirements of applicable codes and appendices should be adhered to:

- a] Low hydrogen electrodes namely, **E-7018 shall be used for** all manual metal-arc welds of shall **courses having a thickness of 12mm or more** and for attachment of shell courses to bottom or annular plates.
- b] High cellulose/rutile type electrodes namely, E-6013 as per the AWS classification SFA 5.1 is acceptable for all other welding.

ESAB, ADVANI OERLIKON & D&H SECHERON make electrodes /approved equivalent will only be permitted to be used in the works. Based on above, fabricator shall furnish samples of welding electrodes to Engineer-in-Charge for approval.

4.0 **DRAWINGS AND DOCUMENTS**

- 4.1 All individual tank data sheets shall have dimensional/design as well as material specification. Final drawing with revisions, if any, shall be issued after award of contract/purchase order.

Contractor shall submit the detailed design calculation for floating roof (F.R.) through HPCL to IIT, Mumbai or any other HPCL approved expert, for vetting and review of design and thereafter Review and approval by HPCL.

- 4.2 Contractor shall prepare all design calculations and fabrication drawings based on the drawings issued on award of contract/purchase order and shall include the following:

1. Drawing index and Schedule of Submission.
2. Design calculation for floating roof wherever called for in the tender document for HPCL review.
3. GA drawing covering all details shown in HPCL data sheets like list of appurtenances, lists of standards and specifications, materials of construction, Tank design data, General Notes including details of test to be conducted on tank, specification and brand-name of welding electrodes to be used etc.
4. Plate layout, details of welding and bill of material for bottom sketch and annular plates.
5. Development details of welding and Bill of Materials for shell including shell extensions showing location of nozzles and stairway on developed shell.
6. Plate layout, details of welding and Bill of Material for Floating Roof/Self supporting cone roof.
8. Details of spiral stairway and extension stairway to still well platform/ LT platform, landings and handrails with bill of materials.
9. Details of wind girders with Bill of Material.
10. Details of rolling ladder and track and Earthing connections with Bill of Material for floating roof tanks.

11. Details of Roof Supporting Structure and Buoys with Bill of Material for Floating roof tanks.
12. Details of shell nozzles and Inlet/ Outlet Troughs and shell earthing cleats with Bill of Material.
13. Details of Primary Foam seal and Secondary Seal and details of earthing shunts for F.R. Tanks.
14. Details of Floating Roof appurtenances, roof stopper and leg supports for Floating Roof including Bill of Materials for FR Tanks.
15. Orientation of floating roof appurtenances, leg supports, plate joints, rolling ladder track etc. for FR Tanks.
16. Details of primary roof drain and Drain sump for F.R. tanks including Bill of Material.
17. Details of still-wells, Gauge hatch and Bill of Material.
18. Details of mounting of Rim vents.
19. Details of Emergency Roof Drains.
20. Details of Foam Cooling System along with Foam makers and orifice plates.
21. Details of Fixed water spray cooling System along with deflector plates along with structural supports mounted atop secondary and tertiary wind girders and spray nozzles and orifice plates.
22. Details of Roof opening for Float type Servo level gauge.
22. Plate cutting diagrams for all free issue material.
23. Plate reconciliation statement for free issue material.

In case the contractor intends to make some modification for accommodating his fabrication facilities or available materials, the same shall be submitted to HPCL for approval with supplementary design calculations. The approved modifications shall be incorporated in fabrication drawing and submitted to HPCL for approval.

- 4.4 Requisite number (as per the Time schedule of this Work/Tender document) of prints of detailed fabrication drawings prepared by contractor shall be sent to HPCL for approval and one copy shall be returned to the contractor after comments/approval. No fabrication / erection shall be carried out without approved drawings.

5.0 FABRICATION AND ERECTION

5.1 Plates

- a] Plates edges shall preferably be sheared or machine cut as per code. All machined parts shall be suitably protected before assembly.

- b] Gas cut plates shall be grounded to the satisfaction of the Engineer-in-Charge.
- c] All formed plates shall be match marked with paint on the concave side with numbers as shown on erection drawings.

5.2 Structural steel and Roof

- a] Structural steel fabrication shall be carried out to the required shapes for making the structure.
- b] A pre-assembly of a sufficient part of roof structure may be called for by the Engineer-in-Charge to assess the correct workmanship.

5.3 Bottom

- a] Bottom slope shall be as indicated in the respective tank drawings.
- b] Overlaps shall be properly cleaned with steel wire brush before welding.
- c] Single pass welds are not permitted.
- d] Arrange the laps to shade the water towards the Bottom drain Nozzle/ shell.
- e] Annular plates shall be assembled by butt welding with backing strips and the sketch plates shall be lap welded to the Annular plates.
- f] Three plates lap joints shall be suitably jogged to a length of 150 mm minimum to facilitate welding. Jogging shall be to the satisfaction of Engineer-in-Charge.
- g] Contractor shall provide a Welding sequence which shall be adopted so as to give minimum shrinkage and distortion and it shall be indicated on fabrication drawings. This shall be approved by Engineer-in-Charge.
- h] Bearing plate under each leg support for floating roof tanks shall be centered and welded to the bottom plate by a continuous fillet weld of size equivalent to bottom plate thickness. Plates shall be 600 mm round or square and 10 mm thick (minimum).

5.4 Shell

- a] Shell erection shall be carried out by Jack – up method only. Calculations for deployment of number of jacks and their placement/ location shall be submitted by the Contractor for HPCL's approval.
- b] All vertical and horizontal shell joints shall be full penetration and full fusion welds using any one of the edge preparations permitted by the Code. Single side butt welds are not permitted.
- c] Top curb angle shall be lap or butt welded to the top course with flange turned outside.

- d] Drain holes of 20 mm diameter suitably staggered shall be provided on the horizontal plates of the stiffening ring (wind girder).
- e] Hand railing shall be provided all around when stiffening ring is used as walkway for floating roof tank.
- f] Curb angle and stiffening ring joints shall not coincide with the vertical shell plate welds.
- g] Vertical joints should preferably be offset by at least 1000mm.
- h] First shell course plates shall be so arranged that the vertical joints clear the annular ring welds or skirt plates welds by at least 300 mm. Vertical joints of the shell courses shall also clear the nozzle attachment welds or reinforcement pad welds as per code and applicable appendices.
- i] Holes shall not be made in shell plates for erection purpose.
- j] Shell plate alignment shall be within the limits specified in code and as approved by HPCL.
- k] For floating roof tanks, internal diameter shall be maintained in all shell courses.
- l] After completion, the inside surface of floating roof tanks walls shall be ground to remove any roughness liable to impair the seal.

5.5 Floating Roof

5.5.1 Overview

- a] Floating Roofs shall be of single deck annular pontoon type construction with or without buoys.
- b] When floating roof is in the highest position, tank shall be capable of holding its design capacity.
- c] Floating roof shall be designed by Contractor considering design data given on each drawing / tender.
- d] Central deck of the floating roof shall be provided with at least one manhole of 750 NB. This manhole shall be provided with a ladder for stepping down to bottom when the roof is in the lowest position. For tanks greater than 8 m dia. Additional manhole of 600 NB shall be provided. These manholes shall have suitable clearance from tanks internals.
- e] On the bottom side of deck, where flexure can be anticipated adjacent to girders supports or other relatively rigid members, full fillet welds not less than 50mm long on 250mm centers shall be used on any plate laps that occur within 300 mm of any such members. Additionally, the remaining lengths of all lap seams shall be stitch welded for 50 mm lengths @ 600mm c/c.

- e] Contractor shall design the parameters of the floating roof such that when floating in product (of specific gravity 0.70) the maximum submergence shall be within 95% of the rim height under conditions as listed below:
- (i) For single deck annular pontoon type external floating roofs for the following conditions:
- The submergence of outer rim when 254 mm rain water is accumulated on the roof with primary Roof Drain inoperative.
 - The submergence of inner and outer rim near the punctured compartments when deck and two adjacent pontoon compartments are punctured.
- f] Contractors shall carry out buoyancy (including tilting) calculations for the floating roof for all the conditions of (g) mentioned above, when it is floating on test water, Calculated value shall be compared with actual submergence measured during floatation test.

5.5.2 Contractor shall submit design calculations for external floating roofs for sufficient buoyancy to keep the roof afloat and with primary roof drains inoperative for the following conditions

- (a) For single deck annular pontoon type external floating roofs considering
- The submergence of outer rim when 254 mm rain water is accumulated on the roof with primary Roof Drains inoperative.
 - The submergence of inner and outer rim near the punctured compartments when deck and two adjacent pontoon compartments are punctured with No water or live load.
- b) Design of leg supports, bleeder vent, emergency drain and primary drains.
- c) Design of pontoons and Deflection of deck and structural integrity of floating roof for annular pontoon type floating roofs when centre deck is loaded by its design rain water or when the centre deck and two adjacent pontoons are punctured.

5.5.3 a) Deck shall have level surface with permanent slope towards the drain sump to avoid stagnation of rain water.

- b) Each compartment of the floating roof shall be provided with a 500 NB manhole with cover.
- c) Each buoy, if provided, shall have 150 NB inspection opening with cover and bolting.
- d) Central deck and pontoon shall be suitably stiffened, if required, and calculation for the structural integrity of the floating roof shall be submitted to HPCL for approval.

5.5.4 **Seal**

Details of Primary foam seal and Secondary seal shall be as per Annexure – 1 to this specification.

5.5.5 **Floating Roof Supports**

- a) Support shall be adjustable to two position
 - 1) The lower position (minimum 1200 mm) shall permit the roof to go as low as possible without interference with any internal accessories and roof seal mechanism.
 - 2) The upper position (for cleaning) shall provide a clearance of 1800mm between the pontoon / deck edges and bottom.
- b) The number of leg supports shall be determined & designed to ensure that while resting they do not deform the tank bottom and roof; the effective length of the pipe support should be taken as 1.5 times of actual length of the pipe support in clean-out position.
- c) Pipe sleeves shall project sufficiently above the roof to take care of flooded condition of roof and extend sufficiently below the roof to prevent escape of vapour (minimum 200 mm).
- d) Pipe support length shall be readjusted after hydraulic testing of tank so as to take care of the initial settlement of the tank bottom.

5.5.6 **Rolling ladder and track** shall be provided as per HPCL Standard Drawings enclosed in this Document.

5.5.7 **Roof Drains**

- a) Roof Drains of Repeatable lay pattern shall be provided by the Contractor as per Manufacturer recommendations with internal supports and shoes/ Guards, Connecting piping duly supported from Roof drain sump to inlet of system and Connecting piping from outlet side of system to Roof Drain Nozzle on shell, if any; Swing check Non return valve with CI body and brass/bronze valve and seat shall be provided for the primary drain for single deck floating roofs. Detailed specifications are provided in a separate section-**Specification for flexible pipe for Tank Roof Drain system for floating Roof tanks.**
- b) The slope of deck leading to primary roof drain sump shall be planned for complete water drainage equivalent to maximum recorded rainfall per hour for given site without allowing any accumulation of water, the deck being at the lowest operating level.
- c) Emergency drain shall be provided to take care of primary roof drain failure. This drain shall be equipped with water seal sump inside the roof to prevent back flow of the stored product. It should start functioning after accumulation of around 200mm of rain fall on deck.
- d) The minimum thickness of drain pipe shall be Sch. 40.

5.5.8 Vents

- a) Roof shall be provided with automatic bleeder vents designed to open before the roof reaches its lowest positions and to close when the roof rises above this point. Also same operation should follow in the clean-out position.
- b) Rim vents of 150 NB at about 30 meter peripheral spacing (minimum two Nos). shall be provided for venting the dead space between stored liquid and seal. They shall be provided with pressure relief valve of one of the two approved makes, set at 20mm water column.

5.5.9 Gauge Well/Anti-rotational Device

Two Nos Gauge hatch with size as indicated in the SOR/drawing shall be provided on diametrically opposite side and shall have a quick opening cover. Gauge hatch shall be spark proof type. One of the Gauge well pipe and Pipe for Level Transmitter/ TE shall be located on either side of Rolling Ladder. This shall also act as anti-rotational device. No additional anti-rotational device is suggested.

5.5.10 Earthing of Floating Roof

- a) Copper cables shall be provided between ladder and track and also between ladder and shell. Two such independent connections should exist in parallel.
- b) Adequate number of earthing shunts shall be provided for the seal.

6.0 APPURTENANCES

6.1 Nozzles & Accessories

- a) All appurtenances and accessories as shown in the respective tank drawings shall be supplied by the Contractor.
- b) Manhole and nozzles with blind flanges shall be provided with gaskets and bolting.
- c) Nozzle and manholes may be shop assembled.
- d) Flange faces shall be varnished and protected by wooden discs using at least three bolts.

- e) All nozzles and accessories shall be prefabricated and attached to the shell plate. The prefabricated assembly shall be stress relieved prior to installation, wherever required as per code and applicable appendices.

6.2 Stairways, Roof Access and Handrailing.

Each tank shall be provided with stairway and roof access. Handrailing if not indicated otherwise on tank drawings shall be provided all around.

6.3 Settling Marker :

Marker shall be provided on the shell, 500mm from the bottom to check tank settlement. Size shall be 50x50x5mm angle and 100mm long. The distance between setting market is approximately 5 meter.(minimum 4 numbers).

Shell settlement measurement shall be made after tank erection, prior to hydro testing and during water filling.

While taking measurement on settling markers, rim space (distance between shell and outer rim) shall also be measured at location corresponding to settling markers for floating roof tanks.

Bottom internal measurements shall be made after hydro testing; such measurement shall be made at all pipe support location. Additional measurements shall be made in annular plate region at 5 meter intervals around the tank shell.

7.0 INSPECTION AND TESTING

Inspection shall be co-coordinated by Engineer-in-Charge at all stages.

7.1 Inspection

- a) All tanks shall be offered for inspection at all stages as desired by Engineer-in-Charge.
- b) HPCL'S representatives shall have free access to the entire contractor's as well as to worksite.
- c) The contractor shall provided all facilities, such as access ladder, lighting, tools and tackles, instruments etc. and personnel to inspectors, for proper execution of their inspection.
- d) All the inspection shall be carried out in accordance with the relevant codes and requirements of drawings and specifications.

- e) Approval of the HPCL'S Engineer-in-Charge shall in no way relieve the contractor of his responsibilities for proper execution of work.

7.1.2 Welding Procedure

- a) Welding procedure qualification shall be carried out as per ASME Boiler and Pressure vessel Code Section IX.
- b) No welding shall be undertaken without approval of the welding procedure and welder qualification test by the Engineer-in-charge.

7.1.3 Radiography and Inspection of Welds

- a) All welds shall be inspected and tested as per Section 6.1 of API 650, Tenth edition and this specification.
- b) All long seams of fabricated nozzles shall be fully radio graphed.
- c) Weld areas to be radio graphed shall be designated by the Engineer-in-charge.
- d) Radiographs shall be taken as soon as welding of the Joint is completed. If repairs are required, these shall be carried out before starting other welds. New radiography examination of such repairs shall also be carried out by the Contractor at his own cost.
- e) Radiograph film length shall be 250 mm min. except if the weld is less than 250 mm long. In such cases, film length shall be full length of weld.
- f) Radiographic film shall be of approved quality.
- g) The radiography films and reports shall be reviewed and approved by a HPCL approved Third Party Agency. The quoted rates are deemed to include same.

7.1.4 Liquid penetrant examination:

Wherever specified in drawing/code, liquid penetrant examination shall be carried out as per specifications and codes. Additionally, all Horizontal and vertical Shell joints including extensions above the Maximum Design Liquid Level shall be Dye Penetrant Tested after Root Run and necessary repairs carried out.

7.2 Testing

All equipment required for testing shall be supplied by the contractor.

Opening other than those used for hydrostatic test or any other test shall be closed by plugs and blind flanges supplied by the contractors.

7.2.1 Bottom test

- a) A detailed description of the proposed test method shall be first submitted for approval to the Engineer-in-Charge.
- b) Vacuum box testing shall be carried out for detection of leaks in the bottom.
- c) The weld joints under the shell periphery shall be tested before erection and welding of first shell course.
- d) Contractor shall test the tank bottom for the entire weld length in the presence of the Engineer-in-Charge and test reports shall be issued accordingly.

7.2.2 Shell Test

- a) Bottom to shell joints shall be tested as follows:
 - i) Inner fillet weld shall be inspected and tested prior to welding the outside fillet weld. Leak test shall be performed with penetrating oil after removal of slag. Oil shall be removed before, welding the outer fillet.
 - ii) Examination for inner fillet to detect cracks shall be performed using either the liquid penetrant method.
- b) All welded lugs and brackets used for erection purpose shall be carefully removed from inside and outside surface of the tank to the satisfaction of the Engineer-in-Charge.
- c) The shell joints above the Design Liquid level and not subjected to Hydrotest shall be radiographed in accordance with API and all such joints shall be Dye penetrant tested for entire length after Root run.
- d) Contractor shall perform the hydrostatic test in the presence of Engineer-in-Charge on each tank after complete erection. Any defects observed during the test shall be repaired by the contractor. **No Hot work shall be permitted after Hydrotest.**
- e) Filling of the tank may be restricted by HPCL Engineer-in-Charge for preloading of foundation and hydrostatic test may be extended over a period of 4 weeks or more to ensure proper settlement of the tanks.

- f) The filling height, for floating roof tanks shall be restricted to maximum height so that weather shield does not go beyond curb angle while carrying out the hydrostatic testing /filling up water. The steps shall be as follows:
 - 1) On completion of tank ad after cleaning, the tank shall be filled with water as follows, unless otherwise specified in the tender documents.
 Filling shall be in 4 stages- 25%, 50%, 75% and 100%. After each stage a load stabilization period shall be observed:
 - 24 hrs between each stage for tanks with a capacity under 10,000 cum.
 Filling rate shall not exceed 1 metre per day till 50% of the tank capacity and thereafter 0.75 m per day. If the settlement reading after 24 hours of filling exceeds 2 mm, the tank may be observed for another 24 hours to ensure that the settlement comes to a halt. Further filling will be carried out only after ascertaining that there is no settlement of the tank at this stage.
 - h) When the tank is full all the weld joints shall be hammered by the Contractor in the presence of Engineer-in-Charge. In case of any defect it shall be repaired and retested by the Contractor as per instructions of Engineer-in-charge.
 - i) Tank shall be emptied at a maximum water level variation rate of 5 metres per day or as per instructions of Engineer-in-Charge.
 - j) All weld repairs shall be done with water level minimum 300 mm below the joint being repaired.

7.2.3 Floating roof testing

Floating roof test shall be as recommended in API Standard 650 Appendix C or Appendix H and also as given below :

- a) During floatation test of roof, contractor shall carry out the proof test as follows on each size of the tank selected by Engineer-in-Charge.
 - i) For annular pontoon type external floating roofs, with primary drains closed, water equivalent to 10” of rainfall over the tank area shall be poured on the deck and in the stabilized state submergence of outer rim shall not exceed 65% of its height at any point.
 - ii) For annular pontoon type external as well as internal floating roofs the condition of deck and two adjacent pontoon compartments punctured shall be simulated and the submergence of inner rim and outer rim at the punctured pontoon shall be compared with the calculated value.
 - iii) Failing to meet the above requirements contractor shall rectify the floating roof and test at his cost till the above requirements are satisfied.
- b) All compartment including buoys shall be tested for liquid tightness.

- c) Sealing devices shall be installed after floatation test.

7.2.5 Nozzle Reinforcing Plates

Nozzle reinforcing plates shall be pneumatically tested at 1.05 kg/cm²g with soap solution. This test shall be carried out before filling the tank for hydrostatic testing.

7.2.6 Primary Drains

Drain pipes in floating roof tank shall be pressure tested with water at 4 kg/cm²g. During the floatation test, the roof drain valve shall be kept open and observed for leakage of the tank contents into pipe drain.

8.0 CALIBRATION

Strapping and Calibration of all tanks shall be done in accordance with IS:2007 & 2008 (Latest editions).

9.0 PAINTING

For details of primer and painting, Painting specification shall be referred to.

10.0 TOLERANCE

10.1 Shell

For tanks to have acceptable appearance and to permit proper functioning of floating roof, they shall have tolerances strictly as specified in applicable codes.

10.2 Floating Roof Tolerance

Tolerance allowed on the annular clearance between shell and floating Roof shall be compatible with the requirement specified by seal manufacturer. This shall be maximum 50 mm radially.

11.0 IDENTIFICATION, PACKING AND TRANSPORTATION

11.1 Identification

Each plate and structural member shall be clearly marked with the specification number, drawing number and assembly number.

11.2 Packing and Transportation

- a. All plates shall be transported in tractor or trailer and shall not be dragged.
- b. All rolled shell plates shall be packed properly to retain the shape and shall be handled carefully to avoid damage during transit.
- c. Contractor shall be responsible for transportation of material fabricated in his workshop or worksite.

12.0 GUARANTEE

Guarantee, if not covered by the General Conditions of contract, shall be as following:

12.1 The entire Work shall be guaranteed in accordance with conditions given in the “General terms and Conditions of Contract”

12.2 Any part of tank found defective within 12 months from the date of Completion of work as per Completion Certificate and not having been subjected to faulty operations or incorrect service

conditions shall be promptly replaced/repared and reassembled by the contractor at his own cost, failing which owner has the right to get the same replaced/repared by others and charge the cost incurred to the contractor.

ANNEXURE-1

FOAM AND CASING FOR SEAL FOR FLOATING ROOF TANKS

1.0 GENERAL

- 1.1 This specification covers the requirements that shall be met as a minimum for core foam and casing for seal for floating roof tanks.
- 1.2 The foam seal installed between the Outer Rim of the Floating Roof and the Tank shell should provide a reasonably close fit and ensure that the product stored inside the tank is not exposed to the atmosphere.

2. CORE FOAM

- 2.1 Core foam shall be of prime quality solid polyurethane foam and of octagon shape. Foam shall be of light weight having appropriate elasticity, little permanent compressive strain and shall have excellent resistance to oil and chemicals.
- 2.2 Core foam shall have the following properties in accordance with ASTM D-3574.
- | | | |
|------|------------------------|-------------------|
| i) | Specific Gravity | 0.018 to 0.024 |
| ii) | Compression set at 50% | Not to exceed 10% |
| | Deflection(Test D) | |
| iii) | Load at 50% deflection | 3000 Pa min. |
- 2.3 Hold down plate of GI(Minimum 16G) as per IS 277 shall be provided.
- 2.3 Rim space of 150 mm and 200 mm shall be provided for tanks up to 30m dia. and above 30m dia. respectively. Foam shall be of octagonal shape and of size 254 mm and 305 mm (across flat ends) for rim space 150 mm and 200mm respectively.

3.0 FOAM CASING

- 3.1 The casing material shall be oil and water resistant.
- 3.2 Material for foam casing shall be Nylon Fabric with Acrylo Nitrile butadiene rubber (BS 2751 Grade BA 60)/ Polyurethane coating. Overall thickness of 2 mm.
- 3.3 Casing shall have the following characteristics.
- | | | |
|----|--|---|
| a) | Acrylo Nitrile Butadiene rubber / Polyurethane Coating | Nylon fabric coated on both sides with Acrylo Nitrile butadiene Rubber/ Polyurethane coating; thickness of 2mm as finished. |
| b) | Hardness, tensile Strength, elongation, Chemical properties, weight and Surface appearance as per BS 2751 Grade BA 60. | |
- 3.4 Casing material shall be examined for volumetric variation in different oils/water as below:
- A) Maximum volumetric variation after immersion in aromatic hydrocarbons at 50 deg. C shall be limited to the following :

48 Hrs.10 Days

a)	in pure toluene	+54%	+57%
b)	in a mixture containing 70% aromatic	+32%	+ 33%
c)	in a mixture containing 30% aromatic	+10%	+ 12%
d)	Iso-octane fuel ASTM A	+ 35 %	+35%

B) Maximum Volumetric variation in water at 70 deg. C shall be limited to the following :

<u>48 Hrs.</u>	<u>70 Days</u>
+ 8%	+ 125%

4.0 **FABRICATION OF SEAL**

- 4.1 Tests as specified above shall be carried out in a reputed laboratory and furnished the results for review / approval.
- 4.2 Contractor shall use proper adhesive of approved quality. Contractor shall give complete procedure for jointing the pieces. The entire work shall be carried out in a clean dry area free of heat, sparks of flame.
- 4.3 Minimum length of foam and casing for foam seal shall not be less than 3 meters. Total circumferential length of foam seal shall be such that a compression of 150 mm is achieved for every 3 meters length of foam seal when installed.

5.0 **GUARANTEE**

The foam seal and casing shall be guaranteed for its durability and satisfactory performance for a minimum period of five years.

6.0 **WEATHER PROTECTOR**

In case of F/R HSD tanks, Weather protector with 18 G thickness GI Sheets to be provided by the Contractor above the Primary Seal as Secondary seals will not be presently provided only in case of HSD tanks at both the locations.

- 7.0 All the technical parameters mentioned herein and the primary seal materials shall be inspected by a HPCL approved Third Party Agency. The costs of such inspection are to be borne by the Contractor only and same are deemed to be included in quoted rates.

SPECIFICATIONS FOR SECONDARY SEAL

The specifications given below are minimum requirements. Contractor may offer seals with specifications superior to those given below with catalogues as part of his Technical Bid .

- 1.0 Vapour Barrier Membrane shall be weldable Polyester PU Coated on both sides on a polyester base fabric. Base fabric shall be polyester 500 D Mesh fabric.
- 2.0 Compression plates shall be GI as per IS: 277 of 18G.

- 3.0 Wiper tip shall possess rain water shedding qualities.
- 4.0 Clamping channels to be manufactured from galvanized steel. All Bolts and nuts shall be zinc plated steel or stainless steel.
- 5.0 SS 304 static discharge shunts at 3 m intervals to be provided.
- 6.0 The secondary seal shall be designed to be mounted to the Floating Roof Rim Plate and completely cover the annular space between the external floating roof and the tank shell wall and provide contact against the tank shell under all operating conditions and should be tight fitting against the tank shell at all operating levels.
- 7.0 The secondary seal compression plates shall be bolted to the F/R rim, each plate overlapping the adjacent plate by 40 mm. The adjacent Secondary seal support compression plates are not to be bolted, welded or riveted together. They will be overlapped with each compression plate free to expand and contract independent of the other plates.

8.0 REQUIREMENTS COMMENTS TEST METHOD/ RESULT

100% Aromatic	40% swell max (7 days)	ASTM D 543
Finished thickness	0.40 mm, min.	
Permeability	0.20 FL. OZ/FT.SQ/24 hr with Toluene vapor	
Finished wt.	500 grams/ sqm	
Abrasion resistance	50 MG/1000 Cycles	ASTM D 3389
TPI Approval	Required	

9.0 Secondary seal tip specifications:

REQUIREMENTS VALUE TEST METHOD/ RESULT

Hardness(RHD)	75+/-5	BS 903 A 26
Tensile strength (MPa)	8 min.	BS 903 A2
Elongation at Break(%)	250%min	BS 903 A2
Tear Strength	25 Nm, min.	BS 903 A3(Angle tear method)
Ozone Resistance}		
50 PPHM/40 deg C/ }		No Cracks
72 hrs/ 100% strain }		
Wear Resistance with}		
H-18 carbide wheel}		2% max. wt. loss
1000 gms, 2000 cycles}		

REQUIREMENTS VALUE TEST METHOD/ RESULT

Liquid Immersion		BS 903 A 16
7 days at 40 deg. C		
Naphtha : Hardness	-15 max	
Tensile strength	-50 max	
Elongation at		
Break, %	-60 max	
Volume swell	-100% max	

- 10.0 Static drain, rim clamp fastener, Tip Bridging and Pro Clip fastener shall be of SS 304.
- 11.0 Protector clip shall be thermoplastic Nitrile.
- 12.0 Volara tape shall be polystyrenitrile.
- 13.0 All the technical parameters mentioned herein and the secondary seal materials shall be inspected by a HPCL approved Third Party Agency. The costs of such inspection are to be borne by the Contractor only and same are deemed to be included in quoted rates.